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COMPETITIVE AND MONOPOLISTIC PRICE-MAKING.

SUMMARY.

Reductions in prices made only to increase sales, 626.—Absolute and relative responsiveness of sales, 627.—Factors determining the absolute responsiveness of sales, 628.—Absolute and relative responsiveness as differentiating competitive and monopolistic price-making, 630—The law of increasing returns and price-making, 631.—Consumers' leagues and limitation of monopoly prices, 632—Responsiveness of business, the law of increasing returns, and discrimination, 633.—Detailed statement of the elements to be considered in price-making and mathematical expression of these elements, 634.

IN any study the simple normally precedes the complex. In approaching, therefore, the problem of price-making (or, if considering railroads, rate-fixing), it is desirable to begin with a single corporation, selling a single product or service at a given price. The managers may believe that this price does not afford the maximum profit. A change in the price is contemplated, and the problem is to determine how great, and in what direction, the change shall be. Let us further assume, to start with, that the contemplated change is a reduction. It then becomes necessary only to determine the limit of that reduction. Afterwards we can determine what principles should control a contemplated addition to a price by considering the addition as a negative subtraction.

Ordinarily, no reduction in the price will be made unless larger sales will result. Obviously, this is not true of monopoly prices alone, tho it has been rightly emphasized in studies of monopoly prices. What is true is that only a monopoly takes considerable account, in fixing its price, of a generally increased or decreased consumption of its output. This is because a generally increased consumption means, for a monopoly, increased sales. For one of a group of competing corporations the crucial question is not whether there is an increase in the total sales of the article or service which it produces: it is interested, not in total sales, but in its own sales. These will increase much more rapidly if a lowering of price diverts towards it the business of competitors than they will because of any increase of total demand stimulated by such a reduction. Even if such a demand is stimulated, the resulting trade must be held against competitors. This seems to be the fundamental distinction between monopoly and competitive price. In either case an important element entering into the problem of lowering (or raising) a price is the effect a proposed change will have on sales, the rapidity with which sales will respond in number and quantity to a change in price. To the monopolistic corporation the desire is that sales of the given article or service should increase in their total amount, since to it belongs the whole of the resulting increase, and since it has no competitors whose trade it can divert. This total increase or decrease of trade in response to price changes may be termed its absolute responsiveness. To one of a group of competing corporations there may be increase or decrease of business without any change in general consumption. It is merely that the business of this corporation increases or decreases with its price changes, relatively to that of rivals. This responsiveness of sales to the price changes of a non-monopolistic corporation may be differentiated as relative responsiveness. It is equally true, then, of competing and of monopolistic firms that no one of them will lower its price on any part of its product unless the reduction promises to result in larger sales, unless trade is adequately responsive. The difference is that in the one case absolute responsiveness and in the other case relative responsiveness is the determining factor.

It is not enough that the amount of product sold should increase when the price is lowered. Increased business involves increased expenses. Not only must the sales increase sufficiently to compensate for the lowered price, they must also increase sufficiently to compensate for the greater expenses of which they are themselves the cause. How large a part these expenses will play in price determination depends partly upon their amount relative to the business, partly upon the rapidity with which they increase with increasing business. In general, industry is carried on, up to a certain point, under the law of increasing returns. A certain equipment is necessarily maintained in about the same completeness despite fluctuations of trade. Part of the expenses, therefore, are relatively fixed; that is, they do not increase proportionately to increased sales. It is doubtful if there is any case where expenses bear continuously, through all fluctuations, the same proportion to the amount of sales. There are, however, variations in the extent to which expenses increase relatively to increasing business;[1] and, as limiting cases are sometimes instructive, it will be well to assume as our first hypothetical examples illustrating the relations of price, responsiveness of sales, and expense to each other,—cases in which the expense bears a definite proportion to the business:[2]—

Price.	*Sales*	*Expense per Sale.*	*Profit per Sale.*	*Profit*
15	100	8	7	700
14	120	8	6	720
13	150	8	5	750
12	200	8	4	800
11	260	8	3	780
10	330	8	2	660
9	410	8	1	410
8	500	8	0	0

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[1] Marshall, Principles of Economics, third edition, pp. 422 and 423, Law of Supply Schedule.

[2] For similar tables see Ely, Monopolies and Trusts, p. 115; also Seligman, Principles of Economics, p. 257, and Seager, Introduction to the Study of Economics, p. 195.

Here we see that the price of highest return is 12, yielding a profit of 800. Given the same relations of prices to expense and the same relations of contemplated changes in price to each other, the price yielding the highest net return might vary widely in different countries, in the same country at different times, and in industries supplying different kinds of commodities. With the element of changing expense per unit of trade absent, the principal factor in determining the price of largest return for a monopoly is the responsiveness of total demand to variations of price.[1] Certain articles because of their high prices are purchased only by the wealthier classes. A small lowering of the price of such an article might make comparatively little difference in the number of sales, while a further reduction might conceivably make possible its sale to the middle classes in large quantities. A reduction from 15 to 14 might, that is, be attended by far less responsiveness in public demand than a reduction from 10 to 9.[2] Further, the marginal utility of an article or service may diminish not continuously, but irregularly, so that, apart from the influence of social stratification, the same change or the same per cent. change of price from different points may be differently responded to in the resulting volume of sales. Purely psychological elements also enter into the problem. Managers of department stores have long since learned that a reduction from $1 to 98 cents is responded to far more sharply in increased sales than the same or even greater reductions from most other points. Articles used by a single class, as surgeons' instruments, and well within the means of that class, would show less responsiveness than articles whose use was, or could be made, more general.

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[1] *Cf.* Marshall, Principles of Economics, third edition, pp. 533 and 534, The Monopoly Revenue Schedule; also Cournot, Recherches sur les Principes Mathématiques de la Théorie des Richesses, pp 61 and 62, or translation by Nathaniel T. Bacon, pp. 56 and 57.

[2] *Cf.* Cournot, p. 47; also pp. 54 and 55; or pp. 45, 50, and 51 of translation.

It now becomes possible to apprehend more clearly what is the only fundamental difference between competitive and monopolistic price-making. Both competing and monopolistic companies fix prices to get the largest net returns. With both, responsiveness of business to reductions in price is an important factor tending towards such reduction. The difference is that the monopolistic corporation is concerned only with absolute responsiveness, with the absolute increase of public demand; while any one of a group of competing firms is primarily interested in relative responsiveness, in the increase or decrease of its trade, by taking from or losing to its competitors. And the reason why competition is so effective in keeping down prices is simply that relative responsiveness is a great deal more marked than absolute responsiveness. Whereas a considerable lowering of price may make comparatively little difference in the total sales of an article or a service, a very slight lowering of price by one competing firm as compared with another is almost certain to increase its sales markedly at the expense of that other. The comparison would be as follows:—

MONOPOLISTIC CORPORATION.

Price.	*Sales.*	*Expense per Sale.*	*Profit per Sale.*	*Profits.*
15	100	8	7	700
14	120	8	6	720
13	150	8	5	750
12	200	8	4	800
11	260	8	3	780
10	330	8	2	660
9	500	8	1	500
8	800	8	0	0

NON-MONOPOLISTIC CORPORATION.

Price.	*Sales.*	*Expense per Sale.*	*Profit per Sale.*	*Profits.*
15	0	8	7	0
14	0	8	6	0
13	0	8	5	0
12	10	8	4	40
11	50	8	3	150
10	150	8	2	300
9	500	8	1	500
8	800	8	0	0

It is clear that the principles of price-making are the same for both, but that the greater responsiveness of trade for any corporation to a lowering of price, when trade can be diverted from rivals as well as increased absolutely, serves to make the price lower. By the reverse action of this principle a small increase in price, which but slightly diminishes the sales of a monopoly, and may even increase its profits, will ruin a non-monopoly.

So far we have assumed expenses to increase *pari passu* with increase of sales. The fact is, of course, that expenses almost never do increase in the same proportion as business. Up to a certain point, the point of maximum efficiency, they increase less rapidly, beyond that point more rapidly, than business. Up to a certain point nearly all industries are thus operated under the law of increasing returns. In the case of many of the great industries, such as transportation and the manufacture of finished steel products, this decrease of the relative expense for each additional unit of business is often marked. This principle has been especially insisted on, and some of its consequences traced in studies of railroad transportation.[1] It will be noted that a relatively decreasing expense account acts in the same way as sharp responsiveness of trade in favor of reducing price. In other words, a given amount of either element takes the place, to some extent, of the other. Hence a monopoly carried on under a law of sharply increasing returns (decreasing relative expense), and selling a product the demand for which increases rapidly with decreasing price, is not likely to be very oppressive. The following table illustrates:—

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[1] See, especially, Hadley, Railroad Transportation, chap iv.

Price.	*Sales.*	*Expense per Sale.*	*Profits per Sale.*	*Profits.*
15	10	12	3	30
14	50	10	4	200
13	100	8	5	500
12	150	6	6	900
11	200	4	7	1,400
10	400	3	7	2,800
9	600	3	6	3,600
8	700	4	4	2,800

In this case the price will be fixed at 9. Contrast with it another case, where relative expenses decrease much less rapidly and sales are less responsive:—

Price.	*Sales.*	*Expense per Sale.*	*Profits per Sale.*	*Profits*
15	100	12	3	300
14	110	11	3	330
13	120	10	3	360
12	130	9	3	390
11	140	8	3	420
10	150	7.8	2.2	330
9	160	7.6	1.4	224
8	170	7.4	0.6	102

Here, because of the difference in the two circumstances referred to, the point of largest return is 11.

Should it ever become possible to organize consumers' leagues made up of persons determined to pay only fair prices, much might be done through the operation of the above-described principles in resisting the demands of monopoly. It would not be necessary that all or nearly all of a monopoly's customers should curtail their consumption. The number necessary to force compliance with demands by combining in agreement not to buy would vary inversely with the extent to which the industry was subject to a law of decreasing relative expenses with increased business (which means also increasing relative expenses with decreased business). A considerable group of such persons with properly accredited officers and a system of investigation could, if allowed free scope by the law, maintain most monopoly prices at a point somewhere near the competitive level.

A feature of trade responsiveness is discrimination. The endeavor is made to get the increased business which results from lowering the price without lowering the price to all. The higgling of the market in the Orient is an example. The trader endeavors to exact a high price from those who will pay it, while charging a much lower price to those whose patronage cannot be otherwise secured. The reduction is not made to every one. It is made only when trade is responsive, and is determined largely by the degree of that responsiveness. In this country, in most retail transactions, discrimination of any serious kind among customers is likely to cause the firm which practises it to lose more than it gains. However, it is still practised in some larger fields, particularly in transportation. Where traffic is sharply responsive,—*i.e.*, where it is relatively responsive because of competition,—we see this discrimination in its extreme form. Special reductions are made in traffic to cities served by several competing roads; while cities situated on the line of any one of these, and not served by the others, receive less satisfactory terms. The reason is that traffic to the city served by several roads is sharply responsive, as regards any one of these roads, to slight variations of rates,—sharply responsive because relatively responsive; while the other is more nearly constant, depending less, as to the traffic the road in question shall receive, on changes of rates.[1]

When there is discrimination in price, it will generally be found that the persons or districts favored do not pay less than cost. Those not favored, however, contribute more largely to profits. When a considerable part of the costs of carrying on business are comparatively fixed, the proportion of these relatively fixed charges assessed on different customers (different sets of sales or parts of business) may vary. Each increment of business must bear its special additional cost; but the fixed charges, like the profits, may be contributed to more largely by some parts of the business than by others. Railroads have, when it seemed necessary, lowered their rates for certain large shippers, or between certain cities, or on certain commodities to such a point as to yield next to nothing above the special additional cost of carrying the traffic in question.[2] The fixed charges, however, remain to be paid, and are assessed on other less responsive traffic.

Summing up the results of the discussion thus far, we find that decrease in price depends directly on the rapidity with which sales will respond to the decrease by enlargement and on the slowness with which expenses increase with this enlargement of business (or the rapidity with which proportionate expense decreases).

Suppose the problem now to present itself to a corporation of lowering somewhat the price on its output. Let us endeavor to state, mathematically, the conditions to be investigated. In the first place let P be the price from which a change is to be made. Then ΔP will be the increment of reduction, and $P - \Delta P$ will be the new price.[1] Similarly, S may represent the former number of sales for a given period; ΔS may stand for the contemplated increase of sales during a period of similar length with lower price; and $S + \Delta S$ the total sales[1] during this second period. The gross income (price multiplied by sales) will then change from PS to $(P - \Delta P)(S + \Delta S)$. The expenses per sale may decrease, remain stationary, or increase with increasing sales. The gross or total expenses are certain to increase. Let us therefore represent the total expenses by E, and the increase of total expenses accompanying ΔS increase of sales by ΔE. With the reduction of price from P to $P - \Delta P$ expenses will increase from E to $E + \Delta E$. The net profits will change from $PS - E$ to $(P - \Delta P)(S + \Delta S) - (E + \Delta E)$. The reduction obviously will not be made unless the new net profits are greater than or as great as the old, unless

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[1] For a further discussion of railroad rate discriminations as caused by conditions of responsiveness see article by the writer in the Yale Review, May, 1907, on "The Basis of Rate-making as Affected by Competition *v.* Combination of Railroads."

[2] Hadley, Railroad Transportation, pp. 116, 117.

$$(P - \Delta P)(S + \Delta S) - (E + \Delta E) \geqq PS - E.$$

And these reductions will continue as long as the left side of the expression is greater than the right, ceasing when the expression becomes an equation.

There is another factor of considerable importance. If the decreased price and the increased number and amount of sales involve greater expense, then more capital must be used in running the business. This increment increase of capital will not be applied unless the net profits accruing on the increment business will yield per year the market rate of interest on the additional capital. It is not enough, therefore, that there should be an increment increase of profit. This increment increase of net profit must be equal to or greater than the market rate of interest on the increment increase of capital. Otherwise the additional capital will be invested elsewhere. If C is the capital formerly used, ΔC the increment extension of investment, and i the market rate of interest for the period assumed, our expression becomes for an average year of that period:—

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[1] *Cf.* Cournot, Recherches sur les Principes Mathématiques de la Théorie des Richesses, pp 57 and 58, translation, pp 53 and 54.

$$(P - \Delta P)(S + \Delta S) - (E + \Delta E) - i\Delta C \geqq PS - E.$$

There is, in addition, an element of risk, which has not been taken into account. When the *entrepreneur*, acting on his best judgment, determines to reduce a price, he is, nevertheless, not certain that sales will respond according to his hopes. He therefore will not make the reduction unless he believes the chances to be in favor of enough additional profit to compensate for this risk. If ΔR is his estimate of the importance or value of the risk, our expression becomes:—

$$(P - \Delta P)(S + \Delta S) - (E + \Delta E) - i\Delta C - \Delta R \geqq PS - E.$$

If the *entrepreneur* is of the gambling type,—*i.e.*, if his coefficient of caution is negative, and the hope of gain appeals more strongly to him than the fear of loss,—risk may serve as an added inducement to the change. In that case ΔR becomes positive, and we have:—

$$(P - \Delta P)(S + \Delta S) - (E + \Delta E) - i\Delta C + \Delta R \geqq PS - E.$$

If, now, we assume this equation to apply only during a limited period of time (as a period of one year), we have an expression for the results that will accrue during that period from a projected increment decrease (or decrement) in price. The actual numbers that must enter into the solution will be different for each kind of business, but the same equation fits all. The form of the expression is such that it fits equally well industries of increasing, decreasing, or proportionate returns (industries of which the relative expenses decrease, increase, or remain the same with increasing sales); that it fits equally well businesses whose sales are sharply responsive to variations in price and those whose trade varies little, even with considerable price changes.

There is but one other factor in price determination which it is desired to introduce. It may sometimes happen that to lower a price during a period of years will not of itself pay, that *during this period* the profits will be less than if the price had been maintained. Nevertheless, it is felt by the managers that ultimate profits will be greater because of the reduction. The reason may be, as in the case of a trade-marked article, that it becomes known to a larger number of people. It may happen that the corporation purposing to reduce a price is one of a group of competing firms, hoping, by means of the reduction, to drive its rivals out of the field, and eventually, as a monopoly, secure higher prices than at first. Or the company planning reduction may be a railroad looking to the ultimate upbuilding and prosperity of the territory it serves, to enable it to secure larger traffic and perhaps higher rates in the future.[1] It may be that such a railroad company will hasten to reduce its rates, in order to discourage the building of competing roads, and thus will be able to prevent so great a permanent fall of rates as would otherwise be inevitable. The principle is, of course, the same, even if the reduction, instead of making possible, eventually, higher rates than before, merely forestalls still greater reductions. In any of these cases the proposed reduction is an investment in succeeding years at the expense of the present. Into the decision as to whether a proposed change shall be adopted enters, therefore, the rate of interest.[2] The ultimate profits must not only be greater than they would else be, they must not only exceed what they would be by as much as the price reduction lessens present profits, but they must compensate for the preceding loss with an equivalent future gain plus interest. In other words, the discounted value of the expected additional or increment income two, three, four, etc., years hence (assuming the previous period of price reduction to be a year), must equal or exceed the loss during the preceding period.[1] It is evident that the lower is the rate of interest, the more likely is the reduction to be made. A low rate of interest means that future gains and losses are discounted but little, are appreciated keenly. During a period of low interest rates, comparatively large present sacrifices will be made for comparatively small future gains.[2]

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[1] See Marshall, Principles of Economics, third edition, pp. 540 and 541.

[2] Since this paper was written, an article has appeared in the Quarterly Journal of Economics, May, 1908, by Professor Alvin S Johnson, dealing especially with the relations of interest to monopoly price, and elaborating for monopolies the point above set forth It is intended here, however, to give the principle a broader application, inclusive of competitive, as well as of monopolistic, price-making.

With the period of reduction extending, as we have assumed, through a year, it would be necessary to determine the mean point in the year of loss concentration, and similarly the points of gain concentration in succeeding years. Without going into these refinements, we may give an approximate statement of the equation. Letting ΔG_2 be the excess gain for the second year, ΔG_3 the excess for the third, etc., we have:—

$$(P - \Delta P)\,(S + \Delta S) - (E + \Delta E) - i\Delta C - \Delta R + \frac{\Delta G_2}{(1+i)} + \frac{\Delta G_3}{(1+i)^2} + \\ \cdot\,\cdot \;\; + . \qquad + \geqq PS - E$$

Expressed in words, this means that the reduction will be made if the resulting profit, plus the discounted value of future excess gains, sufficiently exceeds the profit at the existing price. More accurately stated, it means that price reduction will take place and will continue as long as the resulting gross income, minus the resulting expense, minus the market rate of interest on the necessary increment increase of capital, minus the increment of risk, plus the discounted value of the future excess gains, is greater than the gross income at the existing price, minus the existing expense.[1] It may be pointed out that ΔG_2 is itself a function of future prices, future sales, and future expenses, and similarly with ΔG_3. But it would seem needlessly complicated to restate the equation with the suggested substitutions. Should the problem contemplate an increase in price, it is only necessary to change the sign of ΔP (giving $P + \Delta P$ instead of $P - \Delta P$ in the original equation), and to consider ΔC, ΔR, ΔE, ΔG_2, ΔG_3, etc., as also changed in sign. A reduction may be considered as a negative increase, an increase as a negative reduction.

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[1] See Fisher, Nature of Capital and Income, chap. xiii., on Value of Capital.

[2] The best development of this principle is to be found in The Rate of Interest by Professor Fisher, Macmillan, 1907.

In concluding, it may be well to emphasize the fact that price-making, whether monopolistic or competitive, is based on the same general principles, and that its conditions are expressible in the same formula.

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[1] Transposing.—

$$(P - \Delta P)\,(S + \Delta S) - (E + \Delta E) \geqq PS - E + i\Delta C + \Delta R - \frac{\Delta G_2}{(1 + i)} - \frac{\Delta G_3}{(1 + i)^2} - \dots\ . - \dots.\ -.$$

This gives —

$$PS - S\Delta P + P\Delta S - E - \Delta E \geqq PS - E + i\Delta C + \Delta R - \frac{\Delta G_2}{(1 + i)} - \frac{\Delta G_3}{(1 + i)^2} - \dots\dots - ;$$

$$P\Delta S \geqq S\Delta P + \Delta E + i\Delta C + \Delta R - \frac{\Delta G_2}{(1 + i)} - \frac{\Delta G_3}{(1 + i)^2} - \dots\dots - \dots\dots ;$$

$$\Delta S \geqq \frac{S\Delta P + \Delta E + i\Delta C + \Delta R - \frac{\Delta G_2}{(1 + i)} - \frac{\Delta G_3}{(1 + i)^2} - \dots\dots - \dots\dots}{P}.$$

Similarly —

$$S\Delta P \geqq P\Delta S - \Delta E - i\Delta C - \Delta R + \frac{\Delta G_2}{(1 + i)} + \frac{\Delta G_3}{(1 + i)^2} + \dots\dots + \dots\dots ;$$

$$\Delta P \geqq \frac{P\Delta S - \Delta E - i\Delta C - \Delta R + \frac{\Delta G_2}{(1 + i)} + \frac{\Delta G_3}{(1 + i)^2} + \dots\dots + \dots\dots}{S}.$$